

SENIOR DESIGN 403

Requirements Capture

Robotic Development Boards

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Introduction:

- **Standing Wheelchair Project**
 - The standing wheelchair will enable disabled persons the mobility of a wheelchair with the added benefit of being supported in a standing position. This allows them to interact with people and objects at eye level. Project consists of a motorized wheelchair that has the ability to stand upright. The mechanics of the wheelchair have been designed and assembled. We need to develop motor controls to drive 2 brushless motors, 4 linear actuators and 2 servo motors. The controls will allow the user to choose direction of movement, adjust the position (sitting or standing) of the wheelchair and operate the safety arm that holds the person in place. These will all be controlled with a single joystick.
- **Autonomous Snow Plow Project**
 - Project consists of a robotic snowplow that has the ability to operate autonomously. The snowplow incorporates a laser scanner as well as 2 gps units. The mechanics of the snow plow have been designed and assembled. We need to develop a motor controller to drive 2 brushless dc motors (used to drive the snowplow) as well as 2 linear actuators (used to control the yaw and pitch of the blade). We also need to incorporate a microcontroller to gather data from the gps units and laser scanner. Finally we need to program the microcontroller to enable the snow plow to operate autonomously using the information it gathers from its sensors.
- **H₂ Fuel Cell Powered Cart**
 - The goal of this project is to create a remote controlled vehicle that will be powered primarily by a H₂ fuel cell. We will reuse the motor controllers from the other projects to help create the controls for this vehicle. It will most likely be driven by brushless dc motors and linear actuators. The controller itself will be an ipad, and we will use the technology from a remote controlled ipad car to drive the motors.
- **Motorized Test Bed Cart**
 - To be able to test our design we want to put together a test cart. This project consists of a cart with multiple I/O pins. It can be controlled with multiple kinds of controllers (joystick/ipad). The cart will be used to drive multiple types of motors and actuators for the projects above as well as future projects. The design and assembly of the cart has already been completed.

Requirements:

Control Board

- Have the ability to be implemented into multiple projects as a development board
- Onboard microcontroller for sensor control and autonomous processing (gps, camera, laser range finder, motor speed)
- Input/output terminals must be designed for quick connection and release
- Discrete PWM ports
 - Control the position of the servo by changing the PWM timing between 1 and 2 ms
- Motor feedback ports
- Control board must fit within current project hardware setup

- No larger than current setup
- Interface with aftermarket gps modules
- Discrete power rails for microcontroller and associated hardware

Driver Board

- Must be mountable on current mechanical fixtures
- PCB must be designed in such a way to handle high current loads
- It will be able to be implemented into multiple projects as a dev board
- Must work with different voltage supplies and various battery technologies
- Isolation from low voltage electrically and physically
- PWM input to driver circuit
- Speed/position output to control board for feedback system
- Must be able to drive two 24V DC Brushless Motors
 - Designed to handle up to 2kW
 - Run in Torque Mode
 - Functions contain forward and reverse
 - Independent control allows for turning and steering
- Must be able to drive 12V linear actuators
 - Can obtain one of two programmable positions
- Must be able to drive servo motors
 - Functions contain forward and reverse
 - Operate position between 0 and 180 degrees

Summary:

We plan to make one large project which will meet the requirements of the other four. The project includes the design and implementation of a driver and control board. The driver board will receive instructions from the control board, amplify the signals and pass them to the motors. The controller board consists of a microprocessor and circuitry allowing for a multitude of inputs with outputs designed to connect to the driver board. The microprocessor will have the ability to gather data from a variety of sensors and handheld controllers. It will use these inputs to determine how the motors will be controlled. While developing the dev board (driver and controller board combination) we will put together a test bed prototype cart which can be used to test our designs and show off our abilities. The goal is to build a universal, easily implemented control and driver board that can be used for multiple applications/projects.